```
In [1]:
         import pandas as pd
         import matplotlib
         import numpy as np
         import scipy as sp
         import IPython
         from IPython import display
         import sklearn
        df = pd.read_csv("UCI_Credit_Card.csv")
In [2]:
        df.shape
In [3]:
Out[3]: (30000, 25)
In [4]: df.head()
Out[4]:
            ID LIMIT_BAL SEX EDUCATION MARRIAGE AGE PAY_0 PAY_2 PAY_3 PAY_4 ... BILL_AMT4 BILL_AMT5 BILL_AMT6 PAY_AI
         0 1
                  20000.0
                            2
                                        2
                                                   1
                                                       24
                                                               2
                                                                      2
                                                                            -1
                                                                                   -1 ...
                                                                                                0.0
                                                                                                           0.0
                                                                                                                     0.0
             2
                 120000.0
                                        2
                                                       26
                                                                                   0 ...
                                                                                             3272.0
                                                                                                        3455.0
                                                                                                                   3261.0
                                                              -1
                                                                            0
          2 3
                  90000.0
                                                       34
                                                               0
                                                                                            14331.0
                                                                                                       14948.0
                                                                                                                  15549.0
                                                                                                                             15
          3 4
                  50000.0
                                                       37
                                                               0
                                                                     0
                                                                            0
                                                                                   0 ...
                                                   1
                                                                                            28314.0
                                                                                                       28959.0
                                                                                                                  29547.0
                                                                                                                             20
          4 5
                  50000.0
                                                   1
                                                       57
                                                              -1
                                                                     0
                                                                            -1
                                                                                   0 ...
                                                                                            20940.0
                                                                                                       19146.0
                                                                                                                  19131.0
                                                                                                                             20
         5 rows × 25 columns
```

In [5]: df.describe()

Out[5]:

	ID	LIMIT_BAL	SEX	EDUCATION	MARRIAGE	AGE	PAY_0	PAY_2	PAY_
count	30000.000000	30000.000000	30000.000000	30000.000000	30000.000000	30000.000000	30000.000000	30000.000000	30000.00000
mean	15000.500000	167484.322667	1.603733	1.853133	1.551867	35.485500	-0.016700	-0.133767	-0.16620
std	8660.398374	129747.661567	0.489129	0.790349	0.521970	9.217904	1.123802	1.197186	1.19686
min	1.000000	10000.000000	1.000000	0.000000	0.000000	21.000000	-2.000000	-2.000000	-2.00000
25%	7500.750000	50000.000000	1.000000	1.000000	1.000000	28.000000	-1.000000	-1.000000	-1.00000
50%	15000.500000	140000.000000	2.000000	2.000000	2.000000	34.000000	0.000000	0.000000	0.00000
75%	22500.250000	240000.000000	2.000000	2.000000	2.000000	41.000000	0.000000	0.000000	0.00000
max	30000.000000	1000000.000000	2.000000	6.000000	3.000000	79.000000	8.000000	8.000000	8.00000

8 rows × 25 columns

## In [6]: df.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 30000 entries, 0 to 29999
Data columns (total 25 columns):

#	Column	Non-Null Count	Dtype
0	ID	30000 non-null	int64
1	LIMIT_BAL	30000 non-null	float64
2	SEX	30000 non-null	int64
3	EDUCATION	30000 non-null	int64
4	MARRIAGE	30000 non-null	int64
5	AGE	30000 non-null	int64
6	PAY_0	30000 non-null	int64
7	PAY_2	30000 non-null	int64
8	PAY_3	30000 non-null	int64
9	PAY_4	30000 non-null	int64
10	PAY_5	30000 non-null	int64
11	PAY_6	30000 non-null	int64
12	BILL_AMT1	30000 non-null	float64
13	BILL_AMT2	30000 non-null	float64
14	BILL_AMT3	30000 non-null	float64
15	BILL_AMT4	30000 non-null	float64
16	BILL_AMT5	30000 non-null	float64
17	BILL_AMT6	30000 non-null	float64
18	PAY_AMT1	30000 non-null	float64
19	PAY_AMT2	30000 non-null	float64
20	PAY_AMT3	30000 non-null	float64
21	PAY_AMT4	30000 non-null	float64
22	PAY_AMT5	30000 non-null	float64
23	PAY_AMT6	30000 non-null	float64
24	default.payment.next.month	30000 non-null	int64
dtype	es: float64(13), int64(12)		
memor	^y usage: 5.7 MB		

localhost:8888/nbconvert/html/Desktop/dataset/Crdedit card.ipynb?download=false

In [7]:	<pre>print(pd.isnull(df).sum())</pre>	
---------	---------------------------------------	--

ID	0
LIMIT_BAL	0
SEX	0
EDUCATION	0
MARRIAGE	0
AGE	0
PAY_0	0
PAY_2	0
PAY_3	0
PAY_4	0
PAY_5	0
PAY_6	0
BILL_AMT1	0
BILL_AMT2	0
BILL_AMT3	0
BILL_AMT4	0
BILL_AMT5	0
BILL_AMT6	0
PAY_AMT1	0
PAY_AMT2	0
PAY_AMT3	0
PAY_AMT4	0
PAY_AMT5	0
PAY_AMT6	0
<pre>default.payment.next.month dtype: int64</pre>	0

In [8]: df

Out[8]:

	ID	LIMIT_BAL	SEX	EDUCATION	MARRIAGE	AGE	PAY_0	PAY_2	PAY_3	PAY_4	 BILL_AMT4	BILL_AMT5	BILL_AMT6
0	1	20000.0	2	2	1	24	2	2	-1	-1	 0.0	0.0	0.0
1	2	120000.0	2	2	2	26	-1	2	0	0	 3272.0	3455.0	3261.0
2	3	90000.0	2	2	2	34	0	0	0	0	 14331.0	14948.0	15549.0
3	4	50000.0	2	2	1	37	0	0	0	0	 28314.0	28959.0	29547.0
4	5	50000.0	1	2	1	57	-1	0	-1	0	 20940.0	19146.0	19131.0
29995	29996	220000.0	1	3	1	39	0	0	0	0	 88004.0	31237.0	15980.0
29996	29997	150000.0	1	3	2	43	-1	-1	-1	-1	 8979.0	5190.0	0.0
29997	29998	30000.0	1	2	2	37	4	3	2	-1	 20878.0	20582.0	19357.0
29998	29999	80000.0	1	3	1	41	1	-1	0	0	 52774.0	11855.0	48944.0
29999	30000	50000.0	1	2	1	46	0	0	0	0	 36535.0	32428.0	15313.0

30000 rows × 25 columns

In [9]: df1 = df.copy()

In [10]: df1

Out[10]:

	ID	LIMIT_BAL	SEX	EDUCATION	MARRIAGE	AGE	PAY_0	PAY_2	PAY_3	PAY_4	 BILL_AMT4	BILL_AMT5	BILL_AMT6
0	1	20000.0	2	2	1	24	2	2	-1	-1	 0.0	0.0	0.0
1	2	120000.0	2	2	2	26	-1	2	0	0	 3272.0	3455.0	3261.0
2	3	90000.0	2	2	2	34	0	0	0	0	 14331.0	14948.0	15549.0
3	4	50000.0	2	2	1	37	0	0	0	0	 28314.0	28959.0	29547.0
4	5	50000.0	1	2	1	57	-1	0	-1	0	 20940.0	19146.0	19131.0
29995	29996	220000.0	1	3	1	39	0	0	0	0	 88004.0	31237.0	15980.0
29996	29997	150000.0	1	3	2	43	-1	-1	-1	-1	 8979.0	5190.0	0.0
29997	29998	30000.0	1	2	2	37	4	3	2	-1	 20878.0	20582.0	19357.0
29998	29999	80000.0	1	3	1	41	1	-1	0	0	 52774.0	11855.0	48944.0
29999	30000	50000.0	1	2	1	46	0	0	0	0	 36535.0	32428.0	15313.0
30000 ו	rows × :	25 columns											

In [11]: df1

Out[11]:

	ID	LIMIT_BAL	SEX	EDUCATION	MARRIAGE	AGE	PAY_0	PAY_2	PAY_3	PAY_4	 BILL_AMT4	BILL_AMT5	BILL_AMT6
0	1	20000.0	2	2	1	24	2	2	-1	-1	 0.0	0.0	0.0
1	2	120000.0	2	2	2	26	-1	2	0	0	 3272.0	3455.0	3261.0
2	3	90000.0	2	2	2	34	0	0	0	0	 14331.0	14948.0	15549.0
3	4	50000.0	2	2	1	37	0	0	0	0	 28314.0	28959.0	29547.0
4	5	50000.0	1	2	1	57	-1	0	-1	0	 20940.0	19146.0	19131.0
29995	29996	220000.0	1	3	1	39	0	0	0	0	 88004.0	31237.0	15980.0
29996	29997	150000.0	1	3	2	43	-1	-1	-1	-1	 8979.0	5190.0	0.0
29997	29998	30000.0	1	2	2	37	4	3	2	-1	 20878.0	20582.0	19357.0
29998	29999	80000.0	1	3	1	41	1	-1	0	0	 52774.0	11855.0	48944.0
29999	30000	50000.0	1	2	1	46	0	0	0	0	 36535.0	32428.0	15313.0

30000 rows × 25 columns

In [12]: df.drop('ID', axis=1, inplace=True)

```
In [13]: df
Out[13]:
                  LIMIT_BAL SEX EDUCATION MARRIAGE AGE PAY_0 PAY_2 PAY_3 PAY_4 PAY_5 ... BILL_AMT4 BILL_AMT5 BILL_AMT6
                     20000.0
                                2
                                            2
                                                            24
                                                                    2
                                                                           2
                                                                                                -2 ...
               0
                                                       1
                                                                                                              0.0
                                                                                                                         0.0
                                                                                                                                     0.0
               1
                    120000.0
                                2
                                            2
                                                            26
                                                                           2
                                                                                                0 ...
                                                                                                           3272.0
                                                                                                                      3455.0
                                                                                                                                  3261.0
                                                       2
                                                                   -1
                                            2
                                                                           0
               2
                     90000.0
                                2
                                                                    0
                                                                                                0 ...
                                                                                                          14331.0
                                                                                                                     14948.0
                                                                                                                                 15549.0
                     50000.0
                                2
                                            2
                                                            37
                                                                           0
                                                                                                0 ...
                                                                                                          28314.0
                                                                                                                                 29547.0
               3
                                                                    0
                                                                                                                     28959.0
               4
                     50000.0
                                1
                                            2
                                                            57
                                                                   -1
                                                                           0
                                                                                  -1
                                                                                         0
                                                                                                0 ...
                                                                                                          20940.0
                                                                                                                     19146.0
                                                                                                                                 19131.0
                                            3
           29995
                    220000.0
                                1
                                                            39
                                                                    0
                                                                           0
                                                                                  0
                                                                                         0
                                                                                                0 ...
                                                                                                          88004.0
                                                                                                                     31237.0
                                                                                                                                 15980.0
                                                       1
           29996
                                            3
                    150000.0
                                                            43
                                                                                                0 ...
                                                                                                           8979.0
                                                                                                                      5190.0
                                                                                                                                     0.0
                                                                   -1
                                                                           -1
                                                                                  -1
                                                                                                0 ...
           29997
                     30000.0
                                1
                                            2
                                                            37
                                                                    4
                                                                           3
                                                                                  2
                                                                                         -1
                                                                                                          20878.0
                                                                                                                     20582.0
                                                                                                                                 19357.0
           29998
                     0.00008
                                                                           -1
                                                                                                0 ...
                                                                                                          52774.0
                                                                                                                      11855.0
                                                                                                                                 48944.0
                                                                    1
           29999
                     50000.0
                                            2
                                                                    0
                                                                           0
                                                                                  0
                                                                                                0 ...
                                                                                                          36535.0
                                                                                                                     32428.0
                                1
                                                            46
                                                                                         0
                                                                                                                                 15313.0
                                                       1
          30000 rows × 24 columns
          Target = df['default.payment.next.month']
In [14]:
          Target.head()
In [15]:
Out[15]: 0
                1
                1
           2
                0
           3
                0
          Name: default.payment.next.month, dtype: int64
In [16]: df.drop('default.payment.next.month', axis=1, inplace=True)
```

In [17]: df

Out[17]:

LIMIT_BAL	SEX	EDUCATION	MARRIAGE	AGE	PAY_0	PAY_2	PAY_3	PAY_4	PAY_5		BILL_AMT3	BILL_AMT4	BILL_AMT5
20000.0	2	2	1	24	2	2	-1	-1	-2		689.0	0.0	0.0
120000.0	2	2	2	26	-1	2	0	0	0		2682.0	3272.0	3455.0
90000.0	2	2	2	34	0	0	0	0	0		13559.0	14331.0	14948.0
50000.0	2	2	1	37	0	0	0	0	0		49291.0	28314.0	28959.0
50000.0	1	2	1	57	-1	0	-1	0	0		35835.0	20940.0	19146.0
				•••									
220000.0	1	3	1	39	0	0	0	0	0		208365.0	88004.0	31237.0
150000.0	1	3	2	43	-1	-1	-1	-1	0		3502.0	8979.0	5190.0
30000.0	1	2	2	37	4	3	2	-1	0		2758.0	20878.0	20582.0
80000.0	1	3	1	41	1	-1	0	0	0		76304.0	52774.0	11855.0
50000.0	1	2	1	46	0	0	0	0	0		49764.0	36535.0	32428.0
	20000.0 120000.0 90000.0 50000.0 220000.0 150000.0 30000.0 80000.0	20000.0 2 120000.0 2 90000.0 2 50000.0 1 220000.0 1 150000.0 1 30000.0 1 80000.0 1	20000.0 2 2 120000.0 2 2 90000.0 2 2 50000.0 2 2 50000.0 1 2  220000.0 1 3 150000.0 1 3 30000.0 1 2 80000.0 1 3	20000.0       2       2       1         120000.0       2       2       2         90000.0       2       2       2         50000.0       1       2       1         50000.0       1       2       1               220000.0       1       3       1         150000.0       1       3       2         30000.0       1       2       2         80000.0       1       3       1	20000.0       2       2       1       24         120000.0       2       2       2       2       26         90000.0       2       2       2       34         50000.0       2       2       1       37         50000.0       1       2       1       57                220000.0       1       3       1       39         150000.0       1       3       2       43         30000.0       1       2       2       37         80000.0       1       3       1       41	20000.0       2       2       1       24       2         120000.0       2       2       2       26       -1         90000.0       2       2       2       34       0         50000.0       2       2       1       37       0         50000.0       1       2       1       57       -1                 220000.0       1       3       1       39       0         150000.0       1       3       2       43       -1         30000.0       1       2       2       37       4         80000.0       1       3       1       41       1	20000.0       2       2       1       24       2       2         120000.0       2       2       2       26       -1       2         90000.0       2       2       2       34       0       0         50000.0       2       2       1       37       0       0         50000.0       1       2       1       57       -1       0                  220000.0       1       3       1       39       0       0         150000.0       1       3       2       43       -1       -1         30000.0       1       2       2       37       4       3         80000.0       1       3       1       41       1       -1	20000.0       2       2       1       24       2       2       -1         120000.0       2       2       2       26       -1       2       0         90000.0       2       2       2       34       0       0       0         50000.0       2       2       1       37       0       0       0         50000.0       1       2       1       57       -1       0       -1                    220000.0       1       3       1       39       0       0       0         150000.0       1       3       2       43       -1       -1       -1         30000.0       1       2       2       37       4       3       2         80000.0       1       3       1       41       1       -1       0	20000.0       2       2       1       24       2       2       -1       -1         120000.0       2       2       2       26       -1       2       0       0         90000.0       2       2       2       34       0       0       0       0         50000.0       2       2       1       37       0       0       0       0         50000.0       1       2       1       57       -1       0       -1       0                     220000.0       1       3       1       39       0       0       0       0         150000.0       1       3       2       43       -1       -1       -1       -1         30000.0       1       2       2       37       4       3       2       -1         80000.0       1       3       1       41       1       -1       0       0	20000.0       2       2       1       24       2       2       -1       -1       -2         120000.0       2       2       2       26       -1       2       0       0       0         90000.0       2       2       2       34       0       0       0       0       0         50000.0       2       2       1       37       0       0       0       0       0         50000.0       1       2       1       57       -1       0       -1       0       0	20000.0       2       2       1       24       2       2       -1       -1       -2          120000.0       2       2       2       26       -1       2       0       0       0          90000.0       2       2       2       34       0       0       0       0       0          50000.0       2       2       1       37       0       0       0       0       0          50000.0       1       2       1       57       -1       0       -1       0       0          220000.0       1       3       1       39       0       0       0       0          150000.0       1       3       2       43       -1       -1       -1       -1       0          30000.0       1       2       2       37       4       3       2       -1       0          80000.0       1       3       1       41       1       -1       0       0       0	20000.0       2       2       1       24       2       2       -1       -1       -2        689.0         120000.0       2       2       2       26       -1       2       0       0       0        2682.0         90000.0       2       2       2       34       0       0       0       0       0        13559.0         50000.0       2       2       1       37       0       0       0       0       0        49291.0         50000.0       1       2       1       57       -1       0       -1       0       0        35835.0   <	20000.0       2       2       1       24       2       2       -1       -1       -2        689.0       0.0         120000.0       2       2       2       26       -1       2       0       0       0        2682.0       3272.0         90000.0       2       2       2       34       0       0       0       0        13559.0       14331.0         50000.0       2       2       1       37       0       0       0       0        49291.0       28314.0         50000.0       1       2       1       57       -1       0       -1       0       0        49291.0       28314.0         50000.0       1       2       1       57       -1       0       -1       0       0        35835.0       20940.0

30000 rows × 23 columns

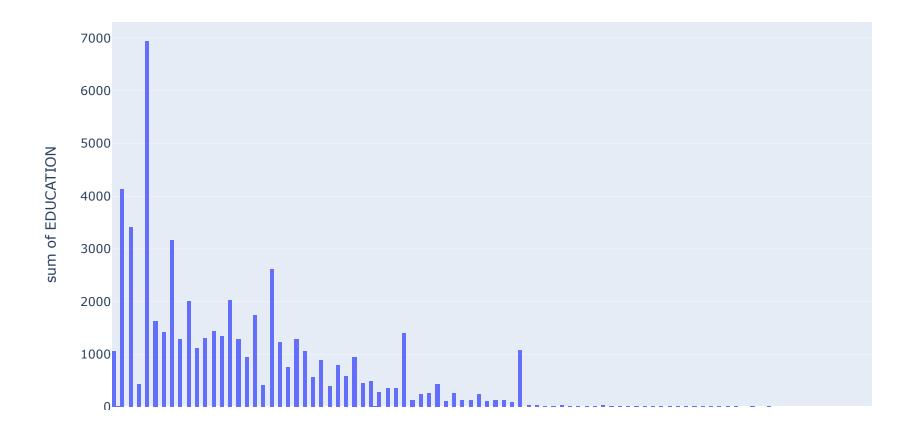
In [18]: !pip install plotly matplotlib seaborn --quiet

```
In [19]: import plotly.express as px
import matplotlib
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline

sns.set_style('darkgrid')
matplotlib.rcParams['font.size'] = 14
matplotlib.rcParams['figure.figsize'] = (10, 6)
matplotlib.rcParams['figure.facecolor'] = '#00000000'
```

```
In [20]: ##Performing visualazation on the dataset

px.histogram(df, x='LIMIT_BAL', y = 'EDUCATION')
```



In [21]: from sklearn.preprocessing import MinMaxScaler
In [22]: ?MinMaxScaler

```
scaler = MinMaxScaler()
In [23]:
           !pip install scikit-learn --upgrade --quiet
In [24]:
           from sklearn.model selection import train test split
In [25]:
           scaler.fit(df)
In [26]:
Out[26]: MinMaxScaler()
In [27]:
           df1
Out[27]:
                     ID LIMIT_BAL SEX EDUCATION MARRIAGE AGE PAY_0 PAY_2 PAY_3 PAY_4 ... BILL_AMT4 BILL_AMT5 BILL_AMT6
                0
                      1
                            20000.0
                                       2
                                                   2
                                                                   24
                                                                            2
                                                                                   2
                                                                                                 -1 ...
                                                                                                              0.0
                                                                                                                          0.0
                                                                                                                                      0.0
                                                               1
                                                                                         -1
                           120000.0
                                                   2
               1
                      2
                                       2
                                                               2
                                                                   26
                                                                           -1
                                                                                   2
                                                                                          0
                                                                                                 0 ...
                                                                                                           3272.0
                                                                                                                       3455.0
                                                                                                                                   3261.0
                                                                                                 0 ...
                2
                      3
                            90000.0
                                                   2
                                                               2
                                                                   34
                                                                            0
                                                                                                           14331.0
                                                                                                                      14948.0
                                                                                                                                  15549.0
                3
                            50000.0
                                                   2
                                                                   37
                                                                                                 0 ...
                                                                                                           28314.0
                      4
                                                                                                                      28959.0
                                                                                                                                  29547.0
                4
                      5
                            50000.0
                                                   2
                                                               1
                                                                   57
                                                                           -1
                                                                                   0
                                                                                         -1
                                                                                                 0 ...
                                                                                                           20940.0
                                                                                                                      19146.0
                                                                                                                                  19131.0
            29995 29996
                           220000.0
                                       1
                                                   3
                                                                   39
                                                                            0
                                                                                   0
                                                                                          0
                                                                                                 0 ...
                                                                                                           88004.0
                                                                                                                      31237.0
                                                                                                                                  15980.0
            29996
                  29997
                           150000.0
                                                                   43
                                                                                                -1 ...
                                                                                                           8979.0
                                                                                                                       5190.0
                                                                                                                                      0.0
                                                                                  -1
                  29998
                                                   2
                                                                   37
            29997
                            30000.0
                                                                                   3
                                                                                                 -1 ...
                                                                                                           20878.0
                                                                                                                      20582.0
                                                                                                                                  19357.0
            29998
                  29999
                            0.00008
                                                   3
                                                                   41
                                                                                  -1
                                                                                          0
                                                                                                 0 ...
                                                                                                           52774.0
                                                                                                                      11855.0
                                                                                                                                  48944.0
            29999 30000
                            50000.0
                                                   2
                                                                   46
                                                                            0
                                                                                   0
                                                                                          0
                                                                                                 0 ...
                                                                                                           36535.0
                                                                                                                      32428.0
                                                                                                                                  15313.0
           30000 rows × 25 columns
          train inputs = scaler.transform(df)
In [28]:
           import numpy as np
In [29]:
```

```
print('train_inputs:', train_inputs.shape)
In [30]:
        train inputs: (30000, 23)
        from sklearn.linear model import LogisticRegression
In [31]:
        ?LogisticRegression
In [32]:
In [33]:
        model = LogisticRegression(solver='liblinear')
        model.fit(train inputs, Target)
In [38]:
Out[38]: LogisticRegression(solver='liblinear')
In [39]: print(model.coef .tolist())
        37035715061759, 0.9187205049158633, 0.7917679618425738, 0.19935302096068125, 0.3456988373286697, 0.1058568026
        9962569, -2.0141366254711817, -0.17029937412430862, -0.4678703188893551, -0.21784092330992533, 0.368864151742
        837, 0.3238596503650357, -3.3021550485904796, -2.2274160898422823, -1.5791957306668691, -1.794122817258403, -
        1.4306618520190948, -1.223023993304811]]
In [40]:
        print(model.intercept )
        [-2.01512022]
        train preds = model.predict(train inputs)
In [41]:
In [42]:
        train preds
Out[42]: array([1, 0, 0, ..., 1, 0, 0], dtype=int64)
In [45]: train_targets = Target.copy()
        test targets = Target.copy()
        val_targets = Target.copy()
```

```
In [46]: train_targets
Out[46]: 0
                   1
          1
                   1
          2
                   0
          3
                   0
          4
                   0
          29995
          29996
                   0
          29997
          29998
                   1
          29999
         Name: default.payment.next.month, Length: 30000, dtype: int64
         train_probs = model.predict_proba(train_inputs)
In [47]:
          train probs
Out[47]: array([[0.49724509, 0.50275491],
                 [0.85169574, 0.14830426],
                 [0.79488522, 0.20511478],
                 . . . ,
                 [0.17459052, 0.82540948],
                 [0.75486279, 0.24513721],
                 [0.73165155, 0.26834845]])
         model.classes_
In [48]:
Out[48]: array([0, 1], dtype=int64)
         from sklearn.metrics import accuracy_score
In [49]:
In [50]: | accuracy_score(train_targets, train_preds)
Out[50]: 0.81023333333333334
         from sklearn.metrics import confusion_matrix
In [51]:
```